Epi Notes

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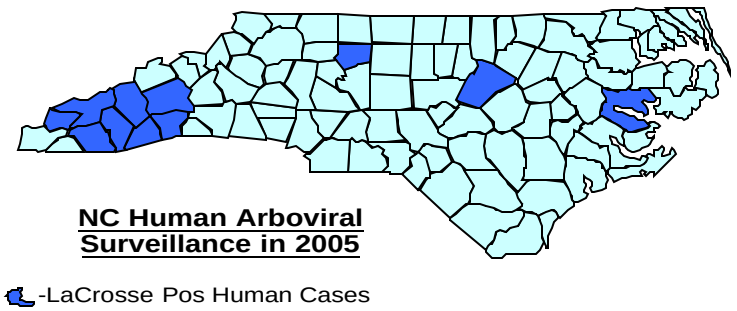
LaCrosse Encephalitis in Western North Carolina, 2006

Prepared by Joey Johnson, Medical Laboratory Supervisor II, Special Serology, N.C. State Laboratory of Health

North Carolina has a wide variety of terrains. From the Atlantic Ocean on the east to the Appalachian Mountains and Tennessee border in the west, the state has a varied geography and ecology. This diverse ecology supports many arthropod vectors, birds, and mammals. In 2005, our state witnessed a dramatic increase in human LaCrosse Encephalitis (LAC) infections. LAC is an arbovirus that is transmitted by arthropod vectors such as mosquitoes. There are hundreds of arboviruses found throughout the world, and many arboviruses can infect humans and cause mild to severe disease. The most familiar arboviruses found in North Carolina are Lacrosse Encephalitis (LAC), West Nile Virus (WNV), and Eastern Equine Encephalitis (EEE), with LAC accounting for the largest number of human infections. While WNV is found statewide, LAC and EEE are largely regionalized, with EEE occurring in the east and LAC in the west. Travel within the state is common, thus these viruses have been detected in humans in areas outside of the normal regions.



The map below illustrates the county of residence of humans infected by LAC in 2005 (32 cases illustrated).

LAC is a disease that resides in eastern chipmunks, gray squirrels, and possibly red foxes. These animals produce high amounts of virus within their bodies. A mosquito bites an infected chipmunk or squirrel extracting blood from the animal, which could contain LAC virus or other arboviruses. When the mosquito bites a human, virus particles enter the human body and infect cells. The virus takes over the infected cells, and causes the cells to start making more

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virus particles that infect additional cells throughout the body. This causes an infection that can result in disease. The viruses are not transferred human to human. The mosquitoes that transmit LAC are formally named Aedes triseriatus, but often are called the "tree hole" mosquito. They earned the nickname because they require standing water in man-made containers or natural tree holes to reproduce and mature. By eliminating these water sources, the number of mosquitoes available to transmit infection will decrease.

LAC infection can present itself with various symptoms. According to the Centers for Disease Control and Prevention (CDC), 80%-90% of children with LAC infection develop a mild febrile illness that includes fever, headache, and vomiting. Symptomatic children have seizures in about 50% of cases and develop encephalitis and meningitis similar to enteroviral infection. LAC infection can produce lethargy and behavioral changes within three to four days post-infection, with seizures progressing to coma in 8-24 hours post-infection. Seizures can occur for up to eight years post-infection in a few cases.

N.C. Public Health Epidemiologists requested assistance from the CDC in September 2005 to help investigate the LAC outbreak in western N.C. From this work, N.C. was able to gain important information and begin to understand the causes of the increased number of infections over the previous years. North Carolina had 32 of the 70 cases (46%) detected in the entire United States in 2005. In 2005, eight adult infections and 24 child LAC infections were detected. The symptoms ranged from headache, fever, and other flu-like symptoms to central nervous system deficiencies such as encephalitis and meningitis. This disease caused more severe symptoms in children than in adults. In 2005, 22 of 32 LAC infections occurred in children under 15 years old, and seven of 32 were over 60 years old. The remaining three human LAC infections were in adults aged 20-42 years old.

Since 2000, North Carolina has seen a steady increase in human LAC cases (Table 1). Overall, we have had a 457% increase in the number of cases in the past five years in. This finding has resulted in heightened surveillance and has increased public health concern. While the cause of the increase is not completely understood, raising awareness of public understanding regarding how and why the disease is transmitted may help decrease the number of infections. Since the discovery of WNV in the United States, arbovirus surveillance has increased in most states, and due to media attention, reporting of other arboviral infections such as LAC has increased.

In 2005, the enhanced surveillance activities incorporated N.C. entomologists who performed mosquito habitat evaluations, mosquito trapping, and small mammal evaluations at residences of LAC infected individuals. This was an attempt to determine where the virus was most prevalent and what had contributed to the infections in the area. Decreasing the mosquito vectors is one way to decrease future infections and gather important data.

Table 1. Increase in LAC cases in North Carolina

Calendar Year	Number of Cases
2000	**7**
2001	**14**
2002	**20**
2003	**24**
2004	**14**
2005	**32**

The information gathered in 2005 and the enhanced surveillance suggests that LAC infections in North Carolina continue to be a serious problem that affects many people, especially children, in the western part of our state. Considerable time and resources on the local, state, and federal levels have been devoted to raising awareness of the potential for arboviral infections, determining the cause and prevention of infection, and the proper diagnosis of the disease. The key public health message is to help prevent infection in and around residential areas by eliminating mosquito habitat, wearing insect repellants, and avoiding outdoor areas at dusk and dawn if at all possible. In 2006, public health surveillance will continue and arboviral testing will be conducted at the N.C. State Laboratory of Public Health. For more information on protection from mosquito bites and decreasing mosquito habitat visit the Public Health Pest Management Website at:
http://www.deh.enr.state.nc.us/phpm/html/mosquitoes.html. ◆

Summer's Here...and so are Harmful Algal Blooms (HABs)

Prepared by Ann Chelminiski, Medical Epidemiologist, Occupational & Environmental Epidemiology Branch

Introduction

Just what is a "Harmful Algal Bloom (HAB)"? A *lgae* are a diverse group of microscopic aquatic organisms that include dinoflagellates, diatoms, cyanobacteria (commonly called blue-green algae) and green, golden and red algae. Algae form the foundation of the aquatic food web in marine, estuarine and fresh waters. An *algal bloom* occurs when these organisms proliferate to form dense concentrations of cells in the water. This may be visible to the naked eye as flecks of algae in the water, discolored water (green, red, brown, milky, etc.) or as scum or foam at the water's edge. Algal blooms can be *harmful* in three main ways—they can indirectly harm aquatic animals by blocking sunlight and decreasing oxygen in the water, they can directly harm fish by elaborating toxins that clog or destroy fish gills, and they can harm animals and humans by elaborating toxins that attack the liver, nervous system or skin. Table 1 summarizes

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(***HAB,** continued from page 2**)***
illnesses associated with ingestion of algal toxins. Not all of these have occurred in North Carolina or even in the United States. A discussion follows about harmful algae known to occur in North Carolina. In general, warm temperatures and longer periods of sunlight encourage algal blooms (as long as other environmental conditions are favorable), so human health problems related to algal blooms are more likely to occur in the warmest months.

HABs in North Carolina

In 1987, Neurotoxic Shellfish Poisoning (NSP) was reported in North Carolina The NSP cases occurred after an algal bloom ("red tide") traveled up the Gulf Stream from Florida waters to the North Carolina. coast, contaminating oysters. Because of that event, the North Carolina. Shellfish Sanitation Section now monitors shellfish waters for the red tide organism, *K. brevis*. Also in 1987, an outbreak of illness consistent with CFP was reported after people ate barracuda caught off the coast of North Carolina. It is hypothesized that the fish ingested the toxins from a coral reef in waters further south, and then migrated northwards to North Carolina. The presence of ciguatera toxins in the fish tissues was not confirmed.

In the late 1990s, public attention was focused on a newly identified dinoflagellate, *Pfiesteria piscicida*. These organisms were detected in estuarine waters in North Carolina in which fish kills occurred. There were also reports of health effects in laboratory workers exposed to water containing *Pfiesteria* organisms. In Maryland, watermen working on the estuaries also reported health problems. The CDC provided funding to North Carolina and other southeastern states to conduct public health surveillance for health problems associated with exposure to estuarine waters—Possible Estuary Associated Syndrome (PEAS). To date, no cases meeting the PEAS case definition have been

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Illnesses Caused by HAB Toxins

Table 1. Summary of Harmful Algal Syndromes

Syndrome/Toxins	Dinoflagellates/Diatoms	Exposure	Range of Symptoms	Incubation Period
Paralytic Shellfish Poisoning (PSP) - saxitoxins	*Alexandrium spp., Gymnodinium catenatum, Pyrodinium bahemense* (dinoflagellate)	Shellfish	Perioral tingling Facial numbness Headache Nausea & vomiting Respiratory distress Death	30 min-3 hours
Amnesic Shellfish Poisoning (ASP) – domoic acid	*Pseudo-nitzschia* spp. (diatom)	Shellfish	Diarrhea Nausea, vomiting Confusion Memory loss Seizures Death	24-48 hours
Diarrhetic Shellfish Poisoning (DSP) – okadaic acid	*Dinophysis* spp., *Prorocentrum* spp. (dinoflagellate)	Shellfish	Diarrhea Nausea & vomiting Abdominal pain	30 min.-2 hours
**Ciguatera Fish Poisoning (CFP) – ciguatoxins, maitotoxin	*Gambierdiscus toxicus, Prorocentrum* spp.	Reef fish	Nausea, vomiting & diarrhea* Headache Blurred vision Reversal of hot/cold sensations Arrhythmias Paralysis	2-6 hours
Cyanobacterial Toxin Poisoning – microcystins, cylindrospermopsin, anatoxins, saxitoxins	Multiple species of cyanobacteria (also called blue-green algae; predominantly freshwater)	Skin contact, ingestion, intravenous (e.g. dialysis)	Nausea, vomiting & diarrhea Skin irritation Jaundice Seizures Liver failure Death	Varies by toxin and route of exposure
**Neurotoxic Shellfish Poisoning (NSP) – brevetoxins	*Karenia brevis* (dinoflagellate)	Shellfish ingestion or inhalation of aerosolized toxin	GI and neurologic: -Similar to those of PSP, but NSP not known to cause death Respiratory irritation	Few min.-hours

Table adapted with permission from Virginia Epidemiology Bulletin, Vol. 104, No.6, courtesy S. Fischer Davis, MD.

*GI symptoms precede the other symptoms of Ciguatera Fish Poisoning
**Documented occurrence in North Carolina.

Hurricane Katrina: North Carolina Conducts After Action Review of Mississippi's Response

Prepared by William Service, Industrial Hygienist and Bill Furney, Information Communication Specialist

In September 2005, the eye of Hurricane Katrina made landfall on the Gulf Coast of Mississippi. The hurricane sent a 20-foot storm surge up to 20 miles inland, caused more than 200 fatalities in Mississippi, and left more than 80,000 Mississippi citizens living in FEMA supplied temporary emergency housing.

In January of 2006, the Mississippi Department of Health (MDH) contacted staff at the N.C. Office of Emergency Medical Services (OEMS) to request assistance with an After Action Review (AAR) of the MDH response to Katrina. The MDH staff drew from the relationship they had developed with our state's OEMS and public health staff resulting from the deployment of the N.C. Mobile Hospital to Waveland, Mississippi following the hurricane (see EpiNotes Vol. 2005-3, pp. 3-4). Holli Hoffman, the OEMS Bioterrorism Coordinator, took charge of the project and assembled a planning team including staff from the N.C. Division of Public Health (DPH), regional OEMS staff and a public health program evaluator from the UNC School of Public Health (UNC-SPH). Over a period of four weeks a plan was devised to collect data to measure the effectiveness of the MDH response and to identify strengths and weaknesses in the MDH response systems.

The Mississippi Department of Health has primary responsibility for all Emergency Support Function 8 (ESF-8) tasks in the state. These responsibilities include emergency and mass medical care, sheltering and special needs sheltering, management of human casualties and public health functions such as morbidity and mortality surveillance, environmental health and injury prevention.

The planning team worked closely with MDH to devise a strategy to collect data using three methods; an on-line survey for emergency responders across the state, face to face interviews with key responders in the state, and citizen interviews or a "community assessment." The framework for the three assessments was the Targeted Capabilities List (TCL) published by the Federal Emergency Management Agency that specifies the capabilities within each emergency support function that an agency should possess to carry out effective emergency response.

An on-line survey was developed that allowed staff from Mississippi public health, medical care, mortuary services, and emergency medical services to complete questionnaires that asked questions about the job functions they fulfilled. Participants were directed to ESF-8 function specific questionnaires as well as to general questionnaires for all

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North Carolina MSM Rapid Behavioral Assessment

Prepared by Martha Buie, Epidemiology and Special Studies Unit, HIV/AIDS Prevention and Care Branch

Background

Little is known about the HIV risk behaviors among men who have sex with men (MSM) living in North Carolina, making it difficult for the health department and local community-based organizations to design appropriate prevention activities. In attempts to meet the specific needs of these men, we often rely on research findings based on MSM living in large metropolitan areas that may not be representative of local populations. To address the deficiency of HIV behavioral risk information from low and moderate HIV morbidity areas, the Behavioral and Clinical Surveillance Branch (BCSB) of the Centers for Disease Control and Prevention offered North Carolina the opportunity and the technical assistance to collect local behavioral risk information from MSM during the 21st Annual North Carolina PrideFest Day Festival and Parade in Durham on September 25, 2005. Pridefest is North Carolina's annual gay, lesbian, bisexual and transgendered festival. The Rapid Behavioral Assessment (RBA) attempts to ascertain the prevalence of HIV risk behavior, the level of substance use and its association with HIV risk behavior, the pattern of HIV testing and the exposure to and use of HIV prevention services. The HIV/STD Prevention and Care Branch intends to use these data to evaluate local HIV prevention programs for MSM and to better target HIV prevention activities accordingly. A brief description of the preliminary survey data follows.

Partners

Of the men in attendance for the 21st Annual North Carolina PrideFest Day Festival, 309 consented to participate in the survey and of those, 95% were North Carolina residents. Two hundred ninety (94%) were considered MSM based on sexual behavior or sexual identity questions; 90% identified as gay. One hundred and six (37%) reported having unprotected anal sex with a man in the past 12 months (see Table 1). The median number of male anal sex partners in the past 12 months was 2.0 (Range: 0-150 sex partners). Of those reporting anal sex during last sex with a man, 50% considered their partner to be a "main partner," or someone to whom they were committed to above all others; 37% considered their last sex partner a "casual partner," or someone to whom they were not committed. Of the 76 men who reported having unprotected anal sex during last sex with a man, 22% were with discordant partners (i.e., the partners were of different HIV status than the men surveyed) or partners of unknown HIV status. Twenty-nine percent of MSM surveyed did not discuss HIV status with all new male sex partners in the past 12 months, 28% had no new partners within that same time period and 33% reported they discussed HIV status with all new male sex partners. Of the men who had new sex partners in the past 12 months,

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(***MSM Rapid Behavioral Assessement,*** *continued from page 4)*
22% met their partners at a bar or club, 24% met over the internet, 4% met in a park or other public cruising area, 4.5% met in an adult bookstore or theater, 4% met at a bathhouse or sex club, 2% met at a private sex party, 2% met on a phone chat line and 2% met at a circuit party.

Substance Use

During the past 12 months, 18% of MSM surveyed (n=290) reported they used non-injection drugs other than marijuana and 4% used crystal meth. Four percent admitted to ever injecting drugs. None of the respondents admitted to injecting drugs or sharing needles in the past year. During the past 12 months, 72% never used drugs before or during sex, 32% never used alcohol before or during sex. Of the 8% who admitted to using drugs before or during last sex with a man, 3% admitted to having unprotected anal sex. Of the 18% who admitted to using alcohol before or during last sex with a man, 5.5% had unprotected anal sex.

Testing Patterns

Seven percent of all MSM surveyed had not been tested for HIV and 25% of the MSM previously tested for HIV had not been tested within the past 12 months. The main reason given for not getting tested was "has not engaged in any risk behavior." Less than one percent gave other reasons for not being tested, including: being afraid of finding out if they had HIV, not having the time or transportation and inconvenient testing locations or hours. Twelve percent of men surveyed had been diagnosed with a sexually transmitted disease in the 12 months prior and of the 129 men who received a syphilis test in the past 12 months, 20 (15.5%) were diagnosed with syphilis.

Exposure to Prevention Messages and Services

In the year prior to the survey, 71% of men surveyed received free condoms, 87% saw HIV prevention posters or signs, 83% saw prevention ads in newspapers or magazines, 76% saw ads on TV or on the radio, 73% read HIV prevention literature or brochures. Forty-one percent had a counselor or outreach worker talk to them about ways to protect themselves from getting HIV and 22% participated in sessions involving a small group discussion about ways to protect themselves and their partners from getting HIV. Five to nine percent of the surveyed MSM were aware of local men's health initiatives ("D-up" and "Know 1 Thing").

Conclusions

Although the majority of men surveyed had recently been exposed to prevention messages and services, additional emphasis on routine HIV testing for sexually active MSM and interventions that promote interpersonal skills and encourage open discussion and disclosure of HIV status are needed. Recent outbreaks of syphilis and other sexually transmitted infections among MSM indicate a resurgence of unprotected sex in this population. To stop HIV transmission, health departments, other health care providers and community-based organizations must continue to provide effective HIV prevention messages and activities to those who demonstrate HIV risk behaviors. Among MSM surveyed, the Internet and bars or clubs were the most popular places to meet partners and these venues provide appropriate places for HIV prevention education and intervention.

Special Acknowledgement

Without the enthusiasm and participation of the RBA volunteers from various community-based organizations and health departments across the state, this endeavor would not have been successful. A special thanks to Triad Health Project, Alliance of AIDS Services- Carolina, Wake County Human Services, SouthLight, Inc., and the HIV/STD Prevention and Care Branch staff who volunteered their time and talents. ◆

Table 1. Number and percentage of men who have sex with men, by selected characteristics

Characteristic	No.	Pct.	Men who had unprotected anal sex with a man in the past 12 months: No.	Pct.
Age Group (yrs)				
18-29	132	45.5%	49	37.1%
30-39	71	24.5%	29	40.8%
40-49	60	20.7%	19	31.7%
?50	27	9.3%	9	33.3%
Race/Ethnicity				
White, non-Hispanic	194	66.9%	75	38.7%
Black, non-Hispanic	43	14.8%	9	20.9%
Hispanic	19	6.6%	10	52.6%
Other*	34	11.7%	12	35.3%
Education				
<12 yrs	10	3.4%	4	40.0%
?12 yrs	280	96.6%	102	36.4%
Sexual self-identity				
Homosexual/Gay	263	90.7%	101	38.4%
Bisexual	26	9.0%	5	19.2%
Other	1	0.3%	0	0.0%
HIV status at interview				
Negative	235	81.0%	89	37.9%
Positive	25	8.6%	10	40.0%
Result pending	5	1.7%	3	60.0%
Never tested	21	7.2%	4	19.0%
Missing	4	1.4%	0	0.0%
Total	**290**	**100%**	**106**	**47.7%**

*Includes those who self-identified as multiple races.

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reported in North Carolina. Research on *Pfiesteria* continues, but determining whether it has human health effects has been difficult because no toxin has been characterized.

In North Carolina freshwaters, the algae of greatest concern are the cyanobacteria, also known as blue-green algae. These ancient, photosynthetic organisms thrive in nutrient-enriched waters and can produce a number of toxins. Depending on the toxin, the skin, liver, nervous system or gastrointestinal tract may be affected. Deaths of animals as well as humans have been documented after exposure to water containing cyanobacterial toxins. In 1996, in Brazil, approximately 50 people died of liver failure after undergoing dialysis with incompletely treated water that contained the algal toxin, microcystin (a hepatotoxin). Cyanotoxins have also been blamed for the death of flamingoes in Africa, alligators in Florida and domestic dogs in Nebraska. To date, there have been no reports of human illness in North Carolina associated with cyanobacteria. Since 2004, the HAB program in the Occupational and Environmental Epidemiology Branch has given funds to the State Laboratory of Public Health to test water samples for the presence of one cyanotoxin, the hepatotoxin microcystin.

North Carolina Public Health Surveillance and Research on HABs

Since 1998, North Carolina has received funding through a cooperative agreement with the Centers for Disease Control (CDC) for the North Carolina. Harmful Algal Blooms Program. The states of Virginia, Maryland, South Carolina and Florida also have HAB Programs. The North Carolina's HAB Program has three main functions—surveillance for HAB-related illnesses, education, and funding research on HABs and other environmental health concerns. Current program activities include a study of recreational water exposure to freshwater cyanobacteria, monitoring for cyanobacterial toxins in North Carolina reservoirs and algal identification workshops for water treatment plant operators in North Carolina. Anyone desiring information or wishing to report a possible HAB-related health problem should call the hotline number given below. ◆

Harmful Algal Blooms Hotline
1-888-823-6915

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responders. More than 1,000 individuals completed the questionnaires prior to February 13.

Face to face interviews were scheduled with more than 100 key responders who performed critical and leadership emergency response functions with or for MDH. A team from North Carolina was created to conduct the interviews by selecting experts in each of the ESF-8 functions from OEMS, DPH, and UNC-SPH.. During the week of February 13, the team traveled across Mississippi to collect 100 interviews with key responders. Data were collected on laptop computers and are currently being compiled and analyzed.

The community assessment was planned and conducted using methods similar to those used by DPH for post-disaster community health and needs assessments in North Carolina (see EpiNotes Vol. 2003-3, pp. 1-2; EpiNotes Vol. 2005-4, pp. 1-2; and MMWR Vol. 53, No. 36, pp. 840-42). Questionnaires were developed to query citizens about services and information they received from MDH specific to ESF-8 TCLs. Cluster samples were selected for three distinct Mississippi populations that were heavily impacted by the hurricane; a rural population in three counties in southern Mississippi, an urban population represented by citizens in Jackson, MS; and a Gulf Coast population represented by citizens south of Interstate 10 and west of Gulfport.

Ten teams of two interviewers from MDH were trained and deployed by the North Carolina team to collect door to door interviews using the sample selected. For the rural and the urban assessments, more than 400 interviews were collected from a random sample of households in the assessment areas. During the week of March 13 a volunteer team of students and faculty from the UNC-SPH deployed with DPH leaders to collect interviews from the coastal population. More than 600 household interviews were collected in total for the three assessments.

A writing team of DPH, OEMS and UNC-SPH staff are compiling and analyzing data and will submit a preliminary report of findings to MDH by mid April. Staff from the NC Emergency Management are assisting with analysis and reporting. ◆

Water, Water, Everywhere! Legionaires' Disease in N.C.

Prepared by Jeffrey Engel, MD, NC State Epidemiologist and Head of General Communicable Disease Control Branch

In 1976, an outbreak of pneumonia occurred at a hotel hosting the American Legion Convention in Philadelphia. Epidemiologic investigation led to the discovery of a new bacterium that was aptly named *Legionella pneumophila*. Since its discovery, *L. pneumophila* has been implicated in numerous outbreaks, both in the community and within healthcare institutions (nosocomial), and is also responsible for sporadic cases of pneumonia in the community. A milder form of the disease known as Pontiac fever was subsequently described as a week-long self-limited flu-like illness without pneumonia.

The ecology of the legionnaires' bacillus is fascinating and pertinent to infections of humans. The natural habitats for the germ are aquatic bodies including rivers, lakes, and streams. *L. pneumophila* can survive in a wide range of environmental conditions including temperatures from 0º to

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(***Legionaires' Disease,*** *continued from page 6**)***
63º C and a pH from 5.0 to 8.5. It can survive for years in water samples stored in refrigerators. In nature it survives by feeding on other microbial life forms including amebas and ciliated protozoa. Unfortunately, it is relatively chlorine tolerant and can contaminate drinking water distribution systems.

Colonization of water distribution systems by *L. pneumophila* depends on water temperature, sediments, and the presence of other microflora. The germ particularly favors warm or hot water reservoirs with relatively low or absent chlorine levels. Humans become infected when they aspirate or inhale aerosolized contaminated water. Nosocomial outbreaks have been linked to contaminated shower heads and tap water used in nebulizers, humidifiers, and ventilators. Community outbreaks have been associated with a mist machine in a grocery store, cooling towers, and hot tubs and spas. The 1976 American Legion outbreak may have been caused by water consumption at the implicated hotel. Interestingly, outbreaks have not been associated with swimming in rivers, lakes, or pools.

People at risk for developing legionnaires' pneumonia are those with compromised immune systems, chronic lung disease, the elderly, and cigarette smokers. In hospitals, post-operative patients and organ transplant recipients are at highest risk.

In North Carolina, legionnaires' disease has been rare. From 1993-2002, anywhere from 11 to 34 cases were reported per year. In that decade, all cases were sporadic and healthcare-associated infections had never been described in the state.

Three investigations of legionnaires' disease in N.C., 2003-2005

During the spring and summer of 2003, my office investigated an unusually high number of legionnaires' pneumonia cases reported to the state by clinical laboratories. Investigations revealed that the 29 patients reported from April through August all had the expected clinical risk factors, no recent travel or hospitalization, and were from different locales across the state. Other than the seasonal cluster, it appeared to be simply more sporadic cases than usual. We notified the Respiratory Disease Branch at the Centers for Disease Control and Prevention (CDC), and to our surprise, they were receiving similar reports form other mid-Atlantic states including Maryland, Delaware, Pennsylvania, and Virginia.

A series of conference calls ensued and state and federal epidemiologists wondered if the increased rainfall the region was experiencing at that time might be responsible. Using the observed and historic legionnaires' disease rates from the involved states and weather data from the National Oceanic and Atmospheric Administration, investigators from the CDC showed a striking association between legionnaires' rates and temperature and rain variables. Compared to the baseline years from 1990-2002, the model suggested that the average increase in rainfall of two inches (experienced in the spring and summer 2003 in the mid-Atlantic region) led to a 20% increase in legionnaires' rates. This analysis has been submitted for publication by the CDC.

In the fall of 2004, we were asked to assist the Cherokee County Health Department with two cases of legionnaires' disease associated with a long term care facility. Since North Carolina had never experienced healthcare-associated legionnaires', I in turn asked for assistance from the CDC. With help from Public Health Regional Surveillance Teams Five and Six and the Office of Public Health Preparedness and Response, active case finding revealed seven cases associated with this outbreak with symptom onset from September 10 to October 16. A detailed investigation into suspected contaminated water sources at the medical center including sampling of sinks, washers, tubs, showers, and water heaters turned up completely negative.

Environmental investigation subsequently led to a cooling tower located at a factory across the street from the medical facility. Cultures from this tower revealed heavy growth of *L. pneumophila* of a similar type previously linked to healthcare-associated outbreaks in other states. Although bacteria could not be cultured, swabs taken from filters of the air handlers located on the roof of the long term care facility were positive for *L. pneumophila* DNA.

In August and September 2004, the remnants of three hurricanes (Frances, Ivan, and Jeanne) swept across the western part of the state, including Cherokee County, and caused significant flooding. Additionally, wind directions were opposite of their normal flow during these storms. Investigators concluded that the most likely cause of the outbreak was hurricane-induced intensive wind and water aerosolization of *L. pneumophila* from the cooling tower to the air intakes of the medical facility. The ensuing environmental contamination then infected a number of vulnerable elderly bed-ridden people.

In April 2005, the Virginia Department of Health called us about an elderly Virginia man who had died of legionnaires' pneumonia. Three of his middle-aged family members were also diagnosed with the disease (and survived) and all were present at a family reunion at a beach house in Nags Head, North Carolina in the previous two weeks. All had used a hot tub spa at the house including use of the jet circulators that aerosolized the water. Working with the Dare County Health Department and the Public Health Regional Surveillance Team One, the beach house was immediately quarantined and evacuated. Inspection revealed a hot tub in use on the second floor balcony. Inspection of the tub showed a chlorine level of zero (recommended level, 1-2 ppm), a water temperature of 37º C, and slime present on the filters and in the tub itself.

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Deviations from Rabies Vaccination Schedule

Prepared by Carl Williams, Public Health Veterinarian, Occupational and Environmental Epidemiology Branch

Recently the Veterinary Public Health (VPH) program has fielded a number of calls concerning deviations from the recommended rabies vaccination schedule, both for pre and post exposure prophylaxis. Below is a summary of how to handle such situations. Of course not all scenarios can be anticipated and you may still need to call the VPH program for guidance, but this should help in a majority of cases. What follows is paraphrased advice from the Chiron Corporation Drug Information Services (the provider of the only currently available rabies vaccine in the US) and other referenced sources.

Pre Exposure: The recommended pre exposure vaccination schedule is to administer one dose on days 0, 7, 21 or 28. This schedule provides rapid and sustained rabies virus neutralizing antibody (RVNA) titers for most individuals. An alternate study reported results from a more widely spaced dosing schedule of days 0, 28, and 56.[1] With this regimen there was a slower increase in RVNA; the maximum RVNA titer achieved three weeks after the third dose was higher than with the standard regimen; and the longevity of RVNA (measured at two years) appeared similar to the standard schedule. Although this alternate regimen is effective, adhere to the recommended schedule (as appears in the package insert) whenever possible. Although minor deviations in the recommended dosing regimen theoretically will not affect the efficacy of vaccination, each case should be considered individually.

Post Exposure: The recommended dosing schedule (if the patient has not been previously vaccinated against rabies) is day 0, 3, 7, 14, and 28 (remember RIG is to be administered on day 0 only). It is important, if possible, that the first four doses be administered in the first 14 days with the doses of vaccine separated by a minimum of three days. If a dose is missed, it should be administered as soon as possible with the aim of completing the post exposure schedule per the approved regimen. If that is not possible, please consult the VPH program. Clinicians should adhere to the recommended prophylaxis schedule. Deviations of a few days are unimportant, but the effects of lapses lasting weeks or months is unknown.[2]

In conclusion deviations and delays in either the pre or post exposure rabies vaccination schedule should not occur. Discuss the importance of maintaining the approved schedule with your patients so that they are unlikely to forget an appointment or try to reschedule an appointment for a later date. Inevitably this will occur, and the guidance above should be helpful, but strive to avoid deviations and delays whenever possible. Understand that whenever a deviation occurs, the product is now being used in a manner for which it is not labeled. This is unlikely to affect efficacy in most cases, but when in doubt the patient's immune status may be monitored by serologic testing 14 to 28 days after the final dose is given. Specimens collected should completely neutralize challenge virus at a 1:5 serum dilution by the rapid fluorescent focus inhibition test (RFFIT).[3] ◆

[1] Nicholson KG, et al. Pre exposure studies with purified chick embryo cell culture rabies vaccine and human diploid cell vaccine: serologic and clinical responses in man. Vaccine 1987;5:208-210

[2] Rupprecht CE, et al. Prophylaxis against rabies. New England Journal of Medicine 2004;351:2626-2635

[3] Human Rabies Prevention – United States, 1999: Recommendations of the Advisory Committee on Immunization Practices. MMWR 1999; 48 (RR-1):1-21

The Next Wave of Multiple Threat Agent Detection

Prepared by Dr. Julie A. Kase, Public Health Scientist, BTEP Unit, NC State Laboratory of Public Health

The CDC has been the driving force behind the development of sensitive, specific and rapid assays to detect agents of bioterrorism. For several years, the rapid assays used by the Laboratory Response Network (LRN) for agents causing such illnesses anthrax, plague and tularemia have relied on a DNA amplification technique known as polymerase chain reaction (PCR). While PCR assays have been highly useful, the detection of important biothreat toxins (e.g. Ricin and Staphylococcal Enterotoxin B) is not possible. Moreover, when an "unknown" environmental sample arrives at the laboratory's doorstep, agent-specific assays must be run, requiring multiple reactions per sample. This limitation is not as evident for one sample, but for multiple samples during a crisis, it is readily apparent. To this end, CDC has been looking for the next wave in multiple biothreat agent detection technology that can increase throughput while not sacrificing speed or quality.

Thanks to the availability of funds and a continuation of the Federal Bioterrorism Grant, the Bioterrorism and Emerging Pathogens (BTEP) Unit at the NC State Laboratory of Public Health (NCSLPH) purchased a Bio-Plex Suspension Array System from BioRad in January 2006. The system utilizes Luminex xMAP technology to allow for the concurrent quantitative analysis (i.e. multiplexing) of up to 100 different targets from a single sample preparation. Using a 96-well microtiter plate format, each well contains a liquid suspension of as many as 100 sets of microscopic beads, each labeled with a spectrally unique color code to distinguish between the separate assays. The beads are dyed with different red and infrared fluorophores in varying ratios to create the distinct

(*continued on page 9*)

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color signatures. Antibodies directed against a particular target are tightly bound to each bead. For assay purposes, each microplate well contains the conjugated beads, sample, and a labeled detection antibody.

Detection and quantitation occurs when the beads pass single file trough the Bio-Plex array reader. One laser excites the bead-embedded dyes to identify the spectrally unique bead while a second laser excites any fluorescing molecules associated with bead-antibody-antigen complex. The fluorescent signals are translated into numerical data with the assistance of Bio-Plex Manager software.

Following newly available LRN procedures, NCSLPH will have the capability of simultaneously detecting *Bacillus anthracis* antigen, *Francisella tularensis* antigen, *Yersinia pestis* antigen, ricin toxin, and Staphylococcal enterotoxin B in environmental samples. All results are considered presumptive and must be supported by other laboratory assays (e.g. culture, PCR).

NCSLPH is excited to have this cutting-edge technology and anticipates fully deploying the LRN Multi-Agent assay in the upcoming months. In the future, the detection and typing of non-bioterrorism agents may be possible as funds and staff are available. Specifically, the NCSLPH has submitted a response to a CDC request for proposals to participate in the external validation of a molecular method to serotype *Salmonella* isolates utilizing the BioPlex/Luminex platform. The BTEP Unit looks forward to many more opportunities for integrating this high throughput assay system into the NCSLPH.◆

(***Legionaires' Disease,*** *continued from page 7**)***
Active surveillance of other parties who had rented the house (and used the tub) showed no further cases of legionnaires' disease. Cultures of the hot tub were sent to the CDC and were positive for *L. pneumophila* and were the same type isolated from lung tissue of the dead Virginia man. Cultures of water from inside the house (sinks and showers) were negative for *L. pneumophila*. The quarantine of the beach house was lifted after the owner removed the hot tub from the property.

These three episodes (literally from "Murphy to Manteo") in the last two years emphasize the influence of environment on human health. Waterborne infections such as legionnaires' disease remain difficult to predict and prevent. Further, remediation and preventive maintenance of water sources may not prevent outbreaks, particularly if they are caused by weather conditions. The public should be reassured that despite these three outbreaks, legionnaires' disease remains relatively rare. Only time will tell if these investigations represent a true increasing trend in North Carolina. ◆

N.C. Public Health NIMS/ICS Training Update

Prepared by Barbara Callahan, Education & Training Coordinator, Office of Public Health Preparedness & Response

North Carolina Public Health professionals have completed over 12,000 required NIMS/ICS training courses (IS-100, ICS-200, ICS-300, ICS-400, IS-700, or IS-800) over the past six months in preparing for their roles as emergency responders and following National Incident Management System (NIMS) compliance guidelines from the Department of Homeland Security. Training strategies to assist the public health workforce in achieving completion of required NIMS/ICS training have been challenging. The North Carolina Public Health Workforce NIMS Training Plan was approved June 27, 2005 and updated on November 30, 2005. This plan provides guidance for public health emergency responders on all levels to meet federal requirements for NIMS compliance, including NIMS/ICS training.

Leadership and support for this statewide initiative have been provided by top state officials. Dr. Leah Devlin, the N.C. Division of Public Health State Health Director, continues to set the example for the Public Health Management Team and others as she progresses through NIMS/ICS command and control training courses. N.C. Department of Health and Human Services (DHHS) Secretary Carmen Hooker-Odom has asked all her DHHS division directors to complete responder level training courses.

All three levels of public health response personnel defined by the NIMS Integration Center are participating in this NIMS training initiative. These response personnel levels are:

1. Executive Level - Public Health Management Team, section chiefs, Preparedness & Response (PHP&R) key response positions, Public Health Regional Surveilance Team Leaders (PHRST), and local health department directors. Local health departments are encouraged to have at least one additional individual trained to be the deputy incident commander for events and/or incidents in which public health plays a major role.

2. Managerial Level - Public Health branch heads, PHRST key response positions, and local health department key middle management personnel (i.e. department heads and supervisors).

3. Responder Level - Individuals reporting to the Public Health Command Center, all PHP&R personnel, PHRST support staff, regional laboratory staff, public health hospital epidemiologists, and at the public health local level, dependent of job position: clinical staff, public health communicable disease staff,

(*continued on page 11**)***

Reported Communicable Disease Cases, N.C., January-March 2006 (by date of report)*

Disease	Year-to-Date (First Quarter)			1st Quarter 2006	Comments / Notes
	2006	2005	Mean (2001-2005)		
Brucellosis	**1**	1	0	**1**	
Campylobacter	**221**	171	120	**221**	
Chlamydia, laboratory reports	**9655**	8702	6527	**9655**	
Cryptosporidiosis	**23**	12	14	**23**	
Dengue	**1**	1	1	**1**	
E. coli, Shiga toxin-producing	**19**	9	8	**19**	Note 1
Ehrlichiosis, Granulocytic	**1**	0	0	**1**	
Ehrlichiosis, Monocytic	**14**	4	3	**14**	Note 2 & 3
Foodborne, other	**60**	21	9	**60**	
Foodborne, C. perfringens	**2**	0	1	**2**	
Gonorrhea	**4303**	4444	4008	**4303**	
Haemophilus influenzae	**14**	24	14	**14**	
Hepatitis A	**34**	24	36	**34**	
Hepatitis B, acute	**49**	42	44	**49**	
Hepatitis B, chronic	**223**	228	173	**223**	
Hepatitis B, perinatal	**2**	0	0	**2**	
HIV/AIDS	**519**	448	430	**519**	Note 4
Legionellosis	**9**	7	5	**9**	
Listeriosis	**11**	6	3	**11**	Note 5
Lyme disease	**8**	14	14	**8**	
Malaria	**9**	8	5	**9**	
Meningococcal disease	**11**	6	14	**11**	
Meningitis, pneumococcal	**14**	11	14	**14**	
Mumps	**1**	4	2	**1**	
Rabies, animal	**77**	107	141	**77**	
Rocky Mountain Spotted Fever	**218**	80	43	**218**	
Salmonellosis	**333**	309	243	**333**	
Shigellosis	**56**	44	105	**56**	
Strepto. A, invasive	**34**	25	35	**34**	
Syphilis, total	**167**	96	149	**167**	Note 6
Tuberculosis	**57**	37	52	**57**	
Toxic Shock Syndrome (TSS)	**1**	1	1	**1**	
TSS, Streptococcal	**4**	0	0	**4**	
Typhoid, acute	**1**	1	1	**1**	
Typhus, epidemic	**1**	0	0	**1**	
Vibrio, other	**2**	2	3	**2**	
Vibrio vulnificus	**1**	0	0	**1**	
Whooping cough	**52**	21	25	**52**	

*Preliminary data, as of 4/17/2006. Quarters are defined as 13-week periods. Only diseases with cases reported in the year 2006 are listed in the table.

Notes: 1. Including E. coli 0157:H7 ("E. coli O157:H7" was disease name until 2/15/2003); 2. Not reportable, or not reportable as such, in this entire time period; 3. Became reportable effective 1/1/2005; 4. Earliest report with HIV infection or AIDS diagnosis;
5. Reportable since 7/2001; 6. Primary, secondary and early latent syphilis.

(***NIMS/ICS Training,*** *continued from page 9**)***

environmental health staff, laboratory professional, public information staff, health educator, legal professional, financial officer, and others.

Public health continues to collaborate with other emergency response partners in the SERC, like Emergency Management, the Fire Marshal's Office, the Community College System, Office of Emergency Medical Services (OEMS), law enforcement, Division of Forestry, and local fire departments to schedule NIMS compliant ICS classes lead by credentialed instructors across the state. PHP&R has sponsored more than 60 ICS classes during the past six months throughout the seven PHRST regions.

The number of credentialed public health ICS instructors has grown from two in the summer of 2005 to ten instructors at this time which has increased public health's training capacity: Nan Rogers with PHRST 1, Linda Taylor with PHRST 2, Keith Henderson and Brian Combs with PHRST 3, Susan Sullivan and Edie Alfano-Sobsey with PHRST 4, Martha Salyers and Keith Rowland with PHRST 6, Belinda Worsham with PHRST 7 and Barbara Callahan with PHP&R. These instructors work with other agency instructors to provide quality NIMS compliant ICS training classes.

There is now a recording and reporting process to document training completed at public health local, regional, and state levels for accountability. State section chiefs are asked to submit monthly reports and local health departments are asked to submit quarterly reports. Spreadsheets are developed, progress is monitored, and data is assimilated and analyzed for grant activities and reports.

The adoption of NIMS and implementation of a NIMS ICS training program by federal fiscal year 2007 has been specified as a condition of eligibility for federal preparedness grants, contracts and other activities. This NIMS/ICS training initiative has defined an approach to the delivery of training to ensure that North Carolina's Public Health Workforce successfully meets that requirement. More importantly, preparation through training and exercise will ensure that North Carolina's Division of Public Health personnel are adequately prepared to fulfill their response role in a unified command environment.

While there has been much progress over the past six months to train and exercise the Public Health Workforce to the NIMS Incident Command System, there is still much to be done. NIMS compliant classes are scheduled by emergency management state and local levels, local fire departments, through the Community College System, Forestry Services, State Highway Patrol, PHP&R, and other emergency responder agencies. No one agency can provide all the NIMS/ICS training which is why public health continues to actively work with other agencies to provide quality programs in a joint collaborative approach. Working together, NIMS training can be made available through the state for all emergency responders. ◆

Employee Recognition: Kathy Dail - Employee of the Quarter

Prepared by Patsy West, Administrative Assistant, Epidemiology Section

Kathy Dail received the Epidemiology Section's Employee Recognition Award for the first quarter of 2006. Ms. Dail was nominated in the category of Leadership.

Ms. Dail began her career in public health in 1981 and since 2002, she had been with the General Communicable Disease Control Branch (GCDC) as a Public Health Nursing Consultant. She has proven to be a leader and has made multiple lasting contributions to public health.

Ms. Dail actively participated in state responses to outbreaks and threats. The SARS outbreak was one of the first events managed at the state level from the Public Health Command Center and Kathy spent countless hours in setting standards for this new base of operations. Kathy works closely with state entomologists, local health departments, private providers, the NC State Laboratory of Public Health and many other laboratories regarding surveillance data for vector borne diseases, tick borne diseases and arboviral encephalitides. Ms. Dail developed the ability for the General Communicable Disease Control Branch to better monitor reported cases that are in the review process; those that require additional information to determine their status with regard to case definition criteria, or were incompletely reported. She also developed the ability of GCDC to receive and process reports of Electronic Laboratory Results by laboratories interested in this type of communication. Because of Kathy's knowledge and understanding of disease control activities conducted by local health departments, she was selected to be involved with defining statewide accreditation standards for the local health departments in North Carolina. Another example of her talent is the work Kathy did on the new detailed course on Surveillance and Control of Communicable Disease for Public Health Professionals working at the local level, primarily local health department nurses and infection control practitioners in hospitals. A major contribution made by Ms. Dail has been her participation in building the NC Electronic Disease Surveillance System. Through her broad knowledge of the principles and practice of surveillance and control of communicable diseases in North Carolina, Ms. Dail is helping to ensure that the best surveillance system is built for North Carolina.

Ms. Dail received a certificate of recognition for her leadership and a gift certificate to a local restaurant from the Epidemiology Section Management Team. ◆

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